# NERL Research Abstract

**EPA's National Exposure Research Laboratory**
**GPRA Goal 1 - Clean Air**

Significant Research Findings

## The EPA Models-3/Community Multiscale Air Quality Modeling System (Release for Windows NT)

**Purpose**

The Models-3 Community Multiscale Air Quality (CMAQ) modeling system was created to integrate major tropospheric air pollutants in a multi-scale "one-atmosphere" structure and to be accessible by both scientific and air quality management users. Air quality models are required for assessment of pollution mitigation strategies to reduce human and ecosystem exposures to air contaminants (e.g., ozone, particulate matter). Earlier releases were available only on Sun workstations. A Models-3 computer framework for Windows NT has been developed and will be distributed for EPA by the National Technical Information Service (http://www.ntis.gov/fcpc/cpn8867.htm). This will allow States and individuals without access to Sun workstations use of the CMAQ model for regulatory air quality assessments required under the Clean Air Act.

**Research Approach**

The approach to developing a multi-species, multi-scale air quality model was to evaluate and incorporate the principal scientific simulation processes existing in current regional and urban air simulation models into a self-consistent modeling structure. Interaction between spatial scales (regional through urban) is done by nesting computational grids. Interaction between pollutant regimes occurs though the linked atmospheric chemistry of tropospheric ozone, fine particles, and acid and nutrient deposition. The modeling system provides a consistent pathway for information flow from one system component to another, making it easier to extend the modeling system for future applications to additional pollutants and processes that may be important. Sub-grid scale features of the CMAQ model include a new plume-in-grid module that treats major point emission sources, such as effluents from coal-fired power plant stacks, as integral plumes until they have reached grid resolution size.

The entire modeling system also consists of a meteorological simulation model and a source emissions model, each providing required data for the CMAQ model. Various interface processors and analysis tools complete the system. The models reside in a computational framework (Models-3) allowing user interaction with graphical user interfaces and providing a larger community with more direct access to air quality models.

**Results and Implications**

Providing this capability on a PC with Windows NT operating system greatly increases the number of users who will be able to accomplish air quality modeling. Science code and the capability available is the same on all computing platforms, as are the visualization and analysis tools. Licenses for software, SAS and ARC/INFO are less expensive for PC's than UNIX workstations and installation for the PC from CD-ROM is much simpler.

The Models-3/CMAQ system on the Windows NT has been benchmarked against other computing platforms. Differences in ozone concentrations varied from -.7 to .04 ppb between the Sun and PC using SMVGEAR chemical solver. The storage space required depends on the application, and the speed of the computer simulations is a function of the computer speed. There are two software products required for the Windows NT version that are not needed for the Sun UNIX version: xwindows emulations package (e.g., Hummingbird Exceed, and Interix). The NT version will assist States that have limited Sun workstation capability and expertise in their implementation of National Ambient Air Quality Standards (NAAQS). It will allow analysts to examine the potential collateral impacts of emission control strategies between pollutant regimes; for example, the possible benefits of reducing fine particles by specifying region-wide reductions of nitrogen oxides for ozone. Also, the modeling system provides the air quality research community an open, flexible platform for testing new simulation processes and extending the system scientifically for future operational and research uses.

**Research Collaboration and Publications**

The research involved in the development and release of the Models-3/CMAQ system was principally a joint effort between scientists and engineers with the EPA National Exposure Research Laboratory's Atmospheric Modeling Division at Research Triangle Park, NC; MCNC's Environmental Programs Division under EPA cooperative agreement CR-822066; and Science Applications International Corporation under EPA contract 68-W1-0055. Publications include:

Byun, D.W., Ching, J.K.S. (Eds). Science Algorithms of the EPA Models-3 Community Multiscale Air Quality (CMAQ) Modeling System. EPA-600/R-99/030. U.S. Environmental Protection Agency, Research Triangle Park, NC. 1999.

U.S. Environmental Protection Agency. Models-3/CMAQ CB4 Tutorial for Windows NT (Single Platform). EPA-600/R-00/031. National Exposure Research Laboratory, Atmospheric Modeling Division, Research Triangle Park, NC. In clearance.

U.S. Environmental Protection Agency. System Installation and Operation Manual for the EPA Third-Generation Air Quality Modeling System (Models-3) for Windows NT. EPA-600/R-00/061. National Exposure Research Laboratory, Atmospheric Modeling Division, Research Triangle Park, NC. In clearance.

**Future Research**

Future research will focus on the evaluation of the Models-3/CMAQ system for ozone and fine particles, and the extension of the modeling capability to selected air toxics. The plan for the computational framework is to extend Models-3/CMAQ to the SGI IRIX environment and to reduce the expense to users for use of proprietary software.

Questions about the Models-3 computational framework may be directed to:
Sharon LeDuc
U.S. Environmental Protection Agency
National Exposure Research Laboratory (MD-80)
Research Triangle Park, NC 27711
Phone: (919)541-1335
E-mail: leduc.sharon@epa.gov

Questions concerning the CMAQ modeling system may be directed to:
Daewon Byun
U.S. Environmental Protection Agency
National Exposure Research Laboratory (MD-80)
Research Triangle Park, NC 27711
Phone: (919)541-0732
E-mail: byun.daewon@epa.gov

Information is also available from the Models-3 EPA website:
http://www.epa.gov/asmdnerl/models3/